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WORLDWIDE PARAGLIDING AND PARAMOTORING MAGAZINE. FOR FREE.

Photo : Anthony Green

SAT AND LOOPING

Two acrobatic manoeuvres unravelled

Herman Pitocco in an Infinite Tumble. Without the SAT, this manoeuvre would probably never have existed.

Photo : Hernan Pitocco

The Inversion and the SAT are two well known acrobatic manoeuvres. The Inversion, a wingover pushed to its limit, was already part of André Bucher's repertoire at the beginning of the nineties. The SAT was discovered in 1999 by Raul Rodriguez, of the Safety Acro Team, when he used it as an avoiding manoeuvre. Serendipity at play. Reproduced at will by this champion, the manoeuvre quickly did the rounds at the world's paragliding sites. Since then, numerous versions have been created, and it is now taught in various different ways. The SAT, in particular, has opened the way to lots of other acrobatic manoeuvres, including the Infinite Tumble. Neither the SAT nor the inversion are anodyne manoeuvres. As with any acrobatic routine, it can go wrong and end very badly. We have decided to have a close look at both these manoeuvres, not to encourage you to try it at home (there are advanced SIV courses for that), but to better understand how they happen. Both manoeuvres demonstrate what our flexible paragliders are capable of when a skilled pilot couples the aerodynamics of his wing, with the pendulum effect resulting from his low centre of gravity relative to the wing. We fly very unusual aircraft, which have certain limits but, equally, they are capable of executing manoeuvres like the SAT which no other plane can do…

The author of this article, Sylvain Dupuis, is one of a new generation of pilots who don't think twice about using a motor to get to an altitude above the plain where they can work. The difference between paramotors and paragliders is disappearing which is one of the principal reasons for **FREE.AERO** combining the two disciplines in one magazine… Numerous professional paraglider pilots like Hernan Pitocco, the first pilot to do an Infinite Tumble on a paramotor, have found added benefits from having a motorised paraglider. As a result, the image of paramotoring has evolved to one of more and more fun, having broadened its horizons from basic flight to include "fighter pilot" manoeuvres.

Nevertheless the manoeuvres described were undertaken as if in free flight without using propulsion. Having a motor adds an extra dimension to the manoeuvres, but at the price of increased risk, which can only be handled by exceptional pilots like Mathieu Rouanet or Francois Ragolski…

INVERSION

The Inversion is, as the name suggests, an inversion of a fully locked spiral dive. That converts the large amount of accumulated energy, which is released in the form of a barrel roll, swinging the pilot high above the canopy.

by Sylvain Dupuis

Translation by Ruth Jessop

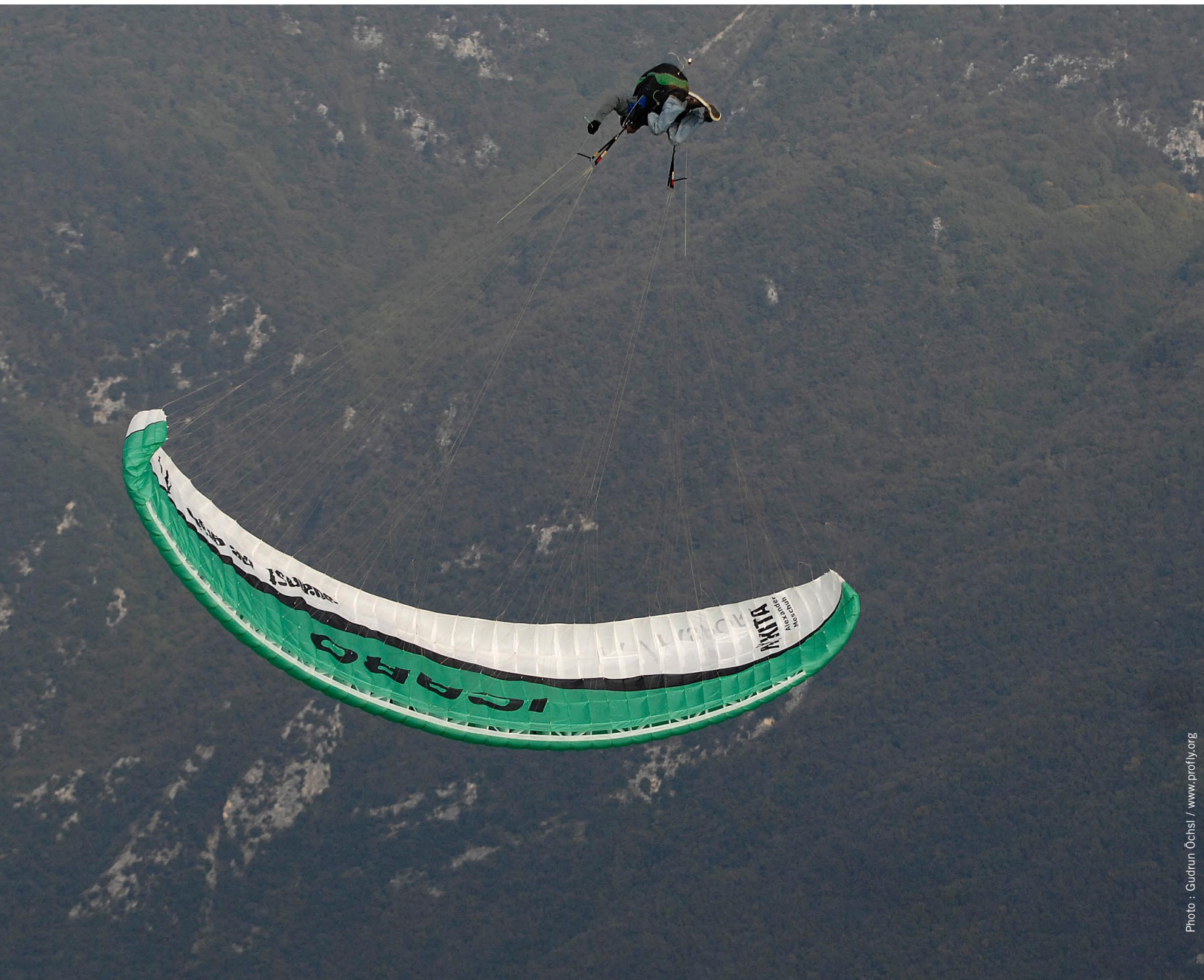

Photo : Gudrun Öchsl / www.profly.org

What is that?

The Inversion, also known as the barrel roll, or - somewhat inaccurately – looping, is a manoeuvre which many pilots dream of doing right from the beginning of their flying career. Who hasn't dreamt of, like an aeroplane, having your head upside down for a few fractions of a second?

Be careful. It's a very dangerous manoeuvre, which can go dramatically wrong (falling into the wing…). In addition, not all wings are capable of performing this manoeuvre. To do it successfully, it's essential to have a wing that is lively on the roll axis. Make sure your wing is capable of doing one and don't try it unless you are on a properly supervised course. The risks are too big; from falling into the wing, to a massive collapse leading to a cravat and autorotation… Know how to get out of these difficult situations before trying an inversion. The absolute minimum is to know how to do a stall to reset your glider and to be in a structured setting with a professional. On the following pages, we will watch, step by step, as a pilot does an inversion…

Photo : Gudrun Öchsl / www.profly.org

Start off with hands up, maximum speed.

Initiate a spiral dive to the left. This step needs to be done perfectly; otherwise the inversion isn't for you.

The wing accelerates rapidly, the G forces increase.

The wing is now facing the ground. You build up lots of energy.

When you're ready, completely release the brakes and lean to the other side (here, to the right) with all your weight. You need to put all your energy into this weight shift, which isn't easy to do. The idea here is to stop the rotation of the spiral so that the wing will stop on its roll axes within the space of a single second! Imagine the pressure needed to do that, and that without touching the brakes…On a paramotor, it's crucial to have an engine with low swing-arms to do this manoeuvre.

Get ready to brake, but wait! Keep your hands high to build up a bit more energy as you swing down. Watch your canopy; always anticipate what is going to happen next.

The wing starts to plunge into a roll as you go under it again. Time to put the turbo on, a bit of right brake! You are still leaning to the right. Now is not the time to hesitate; you have to go through with it otherwise catastrophe awaits.

The effect is immediate. With all the accumulated energy, the change in weight shift and the increased brake, the wing will shoot below the horizon. Put on a bit more inner brake and don't forget to start applying some outer brake. Remember, as with wingovers, not enough outer brake will lead to a big collapse!

You can see here that the braking is almost symmetrical because the outer brake is being pulled more and more!

Always watch the wing. Keep on your brakes; the critical moment is approaching.

Still leaning to the right, still braking hard on both sides. If you're going to have a collapse it'll be now.

You pass the highest point, still with your weigh shift on the same side and lots of brake.

The wing starts to come back up. Here you can start to ease off on the inner brake to calm the roll.

The horizon re-appears; the inner brake is almost completely released. The outer brake prevents the wing coming back up too violently. Modulate your braking according to your wing.

The wing goes back above you. Re-centre yourself and let go of the brakes.

All you need to do now is dissipate the 360° which will follow. At this point, a small collapse like this one will be nothing to worry about.

Photo : Michael Nesler / www.profly.org

The two essential prerequisites to performing an inversion: The wingover and the stall, the latter being a way to sort things out when they go wrong.

Photo : Niviuk

Photo : Niviuk

SAT

The SAT is a legendary manoeuvre which was discovered by Raul Rodriguez. It heralded the start of a new era of acrobatics, giving birth to Asymmetric SATs, Rhythmic SATs, Tumbles and Infinite Tumbles, which are all direct variations. The Infinite Tumble is nothing other than a SAT around a horizontal axis!

By Sylvain Dupuis
Translation by Ruth Jessop

The SAT is a relatively easy manoeuvre and is as aesthetic as it is impressive. It's a bit like a spiral dive pushed to the extreme, as shown in the diagram opposite. Be careful; in contrast to a wingover, which you can work on little by little, step by step, progressively analysing the results, the first SAT can't be a 'work in progress'. You can't do 'little SATs'. And, as always with acrobatics, it can quickly turn into a severe cascade.
Before trying a SAT, memorise it perfectly several months before the first attempt. Imagine the way the wing will react, how it will feel, and most importantly, what you'll need to do if it goes wrong…To do a SAT, you'll need to know how to handle a collapse (you're bound to have one at the beginning) as well as a stall (in a SAT the risk of going into a spin is very high; we'll come back to that later).

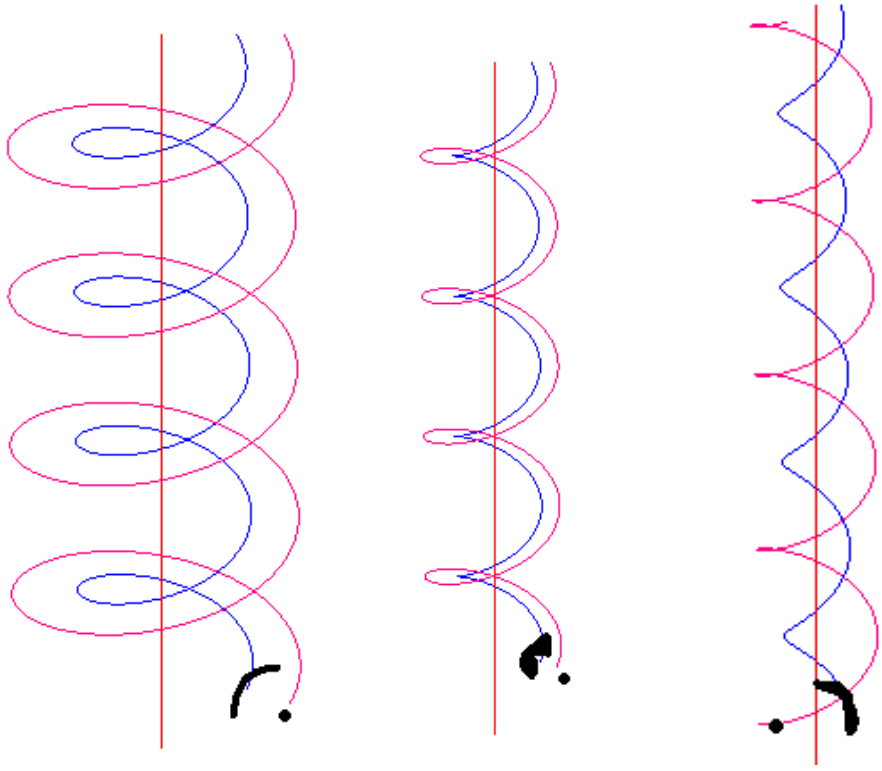

Illustration :Sylvain Dupuis

In blue, the imaginary line left by the wing in red, the one left by the pilot.
1- On the left a little 360. In other words, a weak spiral.
2- A locked in spiral. The speed of the rotation, the G forces and the rate of descent have all increased dramatically. On the other hand, the radius of the turn has decreased. In the most locked in spiral, the blue line is almost aligned with the centre of the rotation.
3- For the SAT (on the right), it's a bit different. The centre of the rotation is between the wing and the pilot. The speed of the rotation is therefore very high! The wing goes forwards, the pilot goes backwards. He'll feel the relative wind coming from behind…

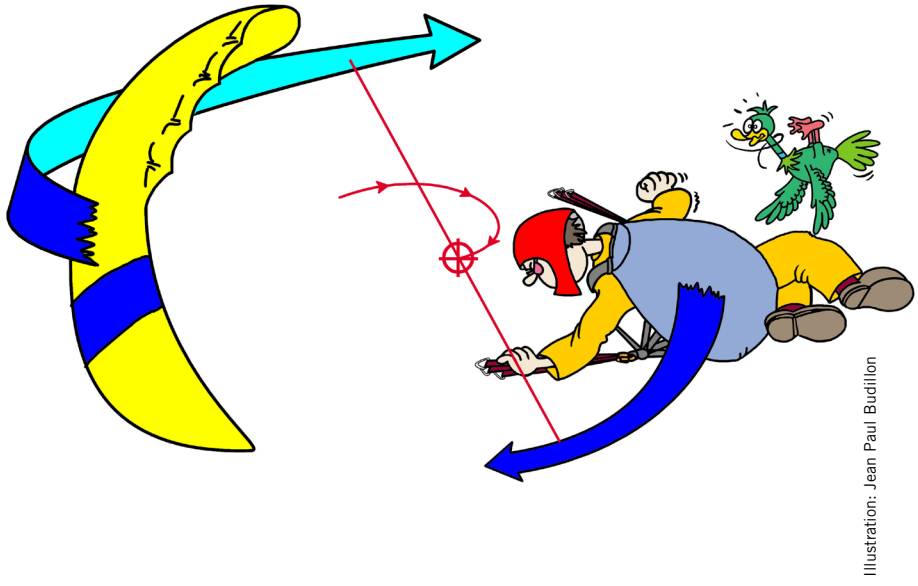

Illustration: Jean Paul Budillon

You'll also need to know how to get out of an autorotation. If you have a cascade, there is a risk that you'll encounter one. Lastly, and the most important of all, have a reserve and know how to use it! Obviously you'll need lots of height (1000m) to be comfortable, and a suitably soft landing underneath you (a lake plus rescue boat for paragliders or forest plus friends for a paramotor).

When you try this manoeuvre for the first time, you should be with a professional instructor in a controlled setting.

Lastly, practice your locked in spiral. During a SAT you'll be faced with strong G forces (between 3.5 and 5 G depending on the wing and how you do it). Be aware that a human being who isn't used to this faints after, on average, several seconds at 4 G... That would be dramatic. Over the next pages we'll be following a SAT manoeuvre...

Photo : Sascha Burkhardt

Here we'll look at a SAT to the right. The left brake needs to be fully off! That's very important. Put the loop over your wrists so that there is no question of not having it in your hand. The G forces in a SAT are so great that during a SAT to the right, you'll be thrown to the left, even though you must lean to the right. You need to hold on very tightly to the top of the left hand group of risers.

Photos : Sylvain Dupuis

Start with your hands up at maximum speed to minimise the risk of a spin. Lean into the right of the harness as much as you can; put everything you've got into this weight shift. Push with your left arm using the risers to support yourself, your elbow should be locked. We recommend that, depending on your wing, you may perhaps need to take a wrap to increase the brake travel. Today, few wings can do without a wrap for a SAT. Paragliding acro wings and in general extremely lively wings (Paramania GTR) are generally OK.

Start by braking gently. Although you need to weight shift as much as you can physically manage, the opposite applies to the brakes: You must be really gentle at this point. The turn is initiated 90% by weight shift and 10% by the brake.

Let the wing accelerate, put on a bit more brake to help it dive, but keep braking moderately.

The wing begins to accelerate strongly. Put on a little bit more brake, still with maximum weight shift to the right.

The wing is now nearly facing the ground, the leading edge obscuring the horizon (very important!). This is the time to brake to enter the SAT. If you brake too much before this exact moment, you'll definitely go into a stall…To now go into a SAT, don't be scared to pull on an additional 15 to 20 cm of brake. The force on the brake is very large, the G force is at its maximum and this is where you need to hold on firmly to keep your weight shift to the right.

Note the difference in the brakes between this photo and the previous one, 15cm was held on briefly. The wing goes into a SAT, it starts to become upright on the other side (right) and you feel yourself going backwards (the relative wind coming from behind). The centre of rotation in the manoeuvre is now between the wing and the pilot. Be careful, as you've now got lots of energy, which will need to dissipate. It is dissipated as rotational speed, which will become very fast. Once again, if you haven't practiced enough (locked in spirals), you risk being caught out by the G forces and becoming spatially disoriented due to the high speed of the rotation. Never do acro if you are below par.

The wing progressively becomes upright. It really is the inner stabilo from the first turn that rises above the horizon. You are now established in a SAT.

You are now well established in a SAT. The more you pull on the controls, the more the wing becomes upright, the more the rotation will decrease (!) and the more the G forces will decrease. Once you've got into a stable SAT the G forces can be less than in a 360°. Be careful not to over-brake. In the same way as when flying, if you slow down too much, you'll stall.

To exit, start by progressively releasing the inner brake (right) and relaxing your elbow gently.

The wing will start to face the ground again. Start to re-centre yourself in the harness.

When you feel yourself accelerating again, you'll need to take the outer brake (left, unused until now) and apply it a little to prevent a collapse on the left (outside). Depending on the wing, this stage can be quite tricky (risk of violent collapses). The little tip collapse on the right (inside), on the other hand, is nothing to worry about.

Adapt the amount of brake to manage the exit, depending on the wing.

The wing will revert to doing a simple spiral which you have already perfectly mastered. There is nothing left to do other than let the energy dissipate, land and celebrate with a beer!

What not to do in a...SAT

Two common mistakes to make during a SAT

Be careful! Going into a SAT too quickly can be dangerous. Here the turn hasn't been correctly initiated: Too much brake, too little weight shift.

The wing isn't going fast enough, it doesn't obscure the horizon. Here, the wing is too big for the pilot: It needs to be given more time to accelerate, whilst a small wing will accelerate quicker.

The pilot continues to force the turn by still putting on too much brake.

Here you can clearly see that the wing is going too slowly, due to its position above the horizon.

The right wing has begun to stall.

The right wing has now completely stalled.

Off into a spin.

This is when it is really important to know how to sort it out. Don't think about doing a SAT if you've never done spin exercises. You could twist, have violent dives etc…

What not to do in a...SAT

In contrast to the series of photos above, here the entry into the SAT is too slow! The wing gathers too much speed, resulting in a nice collapse on the opposite side from the rotation (collapse on the left for a SAT to the right). A simple pull on the left brake and a return to a spiral will be enough to reopen the wing. Don't forget, the higher you are, the safer you are. The ground hurts…


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